AUTUMN AND WINTER FOOD HABITS OF BOBCATS IN WASHINGTON STATE[1]

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ABSTRACT.— The stomach contents were examined from 324 western Washington bobcats (*Felis rufus*) and 123 from eastern Washington taken by hunters from 1976 through 1980, for major prey items as well as sex- and age-related differences in diet. Western Washington bobcats ate primarily mountain beavers (*Aplodontia rufa*) (42% occurrence) and snowshoe hares (*Lepus americanus*) (26%). Within that population females ate larger quantities of smaller prey such as douglas squirrels (*Tamiasciurus douglasi*) and lesser amounts of deer (*Odocoileus* sp.) than males. Bobcat diets in eastern Washington were more diverse; main foods consisted of lagomorphs (*Sylvilagus nuttallii, Lepus* sp.) (20%), red squirrels (*Tamiasciurus hudsonicus*) (15%), deer (11%), and voles (*Microtus* sp.) (11%). Age-related differences were most prevalent in this population, with adults consuming larger quantities of deer and larger prey than did kittens.

Food habits, the most widely studied aspect of bobcat (*Felis rufus*) biology, are known for most of the range for this species. Earlier studies of bobcat food habits were concerned primarily with prey identification and the impact of predation on game species (Marston 1942, Pollack 1951, Erickson 1955, Progulske 1955, Gashwiler et al. 1960, Petraborg and Gunvalson 1962). Only recently have investigators considered differences in diet related to sex and age (Fritts and Sealander 1978, Toweill 1983). Differential exploitation of prey resources should benefit species such as the bobcat, in which there is sexual dimorphism in body size (Selander 1966) and the female raises the young alone (Ewer 1968). Age-related differences in diet also may occur in young solitary carnivores whose hunting capabilities may not be fully developed.

This paper reports bobcat food habits in Washington state from 1976 through 1980. Important prey items, as well as differences in diet related to sex and age, are discussed. Two geographically distinct populations with separate faunas occur in the state: *Felis (Lynx) rufus fasciatus* occurs west of the Cascade Mountain crest (western Washington) and *F. r. pallescens* is found east of this divide (eastern Washington) (Hall and Kelson 1959).

METHODS

Bobcat carcasses were collected from hunters by Washington Department of Game personnel between October and March (legal hunting seasons) from 1976 through 1979 in western Washington, and from 1976 through 1980 in eastern Washington. Stomach contents were washed in a fine mesh sieve, drained and separated (Korschgen 1971). Food items were identified to genus, and to species when possible, by diagnostic bones or hair, or in a few cases by hair impression (Moore et al. 1974). Percent occurrence (number of occurrences of a species/total number of stomachs × 100) and relative weight (total weight of a species/total weight of all species × 100) were determined for each food item.

Bobcat ages were determined by counting cementum annuli in the canine root tip (Crowe 1972). Bobcats with an open root canal or lacking permanent dentition were aged as kittens (<1 year old) (Crowe 1975); other age categories were yearling (1–2 years old) and adult (≥2½ years old).

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Western and eastern Washington populations were treated separately in the analyses of specific food items but were compared with respect to total stomach content weights and number of empty stomachs. The relative weights of food items were analyzed with two-way multivariate analyses of variance (ANOV) (Morrison 1976). This multivariate investigation of sex and age effects was supplemented by univariate ANOV on relative weight and percent occurrence of each food item and by using Fisher's protected lsd procedure (Steele and Torrie 1980) where necessary to determine pairwise differences. Because of the large variation involved, we used a significance level of $p<0.10$. We combined data across years within populations since there was no variation in proportions.

RESULTS

Mountain beavers (*Aplodontia rufa*) and snowshoe hares (*Lepus americanus*) were the primary food items found in 324 western Washington bobcat stomachs (Table 1); together they occurred in 68% of the stomachs and constituted 83% of the total prey weight consumed. Mammalian prey were found in 96% of the nonempty western Washington stomachs and accounted for 98% of the total prey weight consumed.

Food habits of eastern Washington bobcats were more diverse than bobcats in western Washington (Table 2). The primary food items were lagomorphs (*Sylvilagus nuttallii*, *Lepus townsendii*, and *L. californicus*), red squirrels (*Tamiasciurus hudsonicus*), deer (*Odocoileus hemionus* and *O. virginianus*), and *Microtus* sp. These four prey categories were found in 57% of the eastern Washington bobcat stomachs and composed 73% of the total prey weight. Mammals were eaten 80% of the time and accounted for 85% of the prey weight consumed.

Stomachs of eastern Washington bobcats were empty more often than western Washington specimens ($p<0.10$); the average weight of stomach contents in eastern Washington (empty stomachs excluded) was less than that of western Washington bobcats ($p<0.02$) (Table 3). In western Washington, the average weight of stomach contents of males was greater than for females ($p<0.004$). Stomach content weights differed between adults and kittens ($p<0.07$); no difference was found between yearlings and adults or kittens. In eastern Washington, no significant age or sex differences were found in average stomach content weights. We obtained these same results for both populations when all stomachs (empty and nonempty) were considered.

For western Washington bobcats, the relative weight of prey remains differed between male ($n=174$) and female ($n=139$) bobcats ($p<0.02$). Thus, male stomachs averaged 7.1 ± 25.2 g ($\bar{x}$ ± SD) of deer and 5.1 ± 20.9 g of other mammals compared to 1.0 ± 6.8 g and 0.7 ± 8.5 g for females, respectively ($p<0.008$; 0.03); female stomachs averaged 9.3 ± 27.8 g of douglas squirrels (*Tamiasciurus douglasi*) compared to 4.6 ± 19.2 g for males ($p<0.07$). Although there were no

TABLE 1. Stomach contents of 324 western Washington bobcats collected from 1976 through 1979.

	Percent occurrence	Relative weight (%)
MAMMALS		
Aplodontia rufa	42	50
Lepus americanus	26	33
Tamiasciurus douglasi	10	3
Odocoileus sp.	7	7
Microtus sp.[a]	4	1
Glaucomys sabrinus	1	1
Castor canadensis	1	1
Sorex sp.[b]	1	tr[c]
Felis rufus	1	3
Ondatra zibethica	1	tr
Cervus canadensis	tr	tr
Peromyscus maniculatus	tr	tr
Erethizon dorsatum	tr	tr
Scapanus orarius	tr	tr
Unidentified mammal	2	tr
Total	96	98
BIRDS		
Troglodytes troglodytes	3	tr
Melospiza melodia	1	tr
Pipilo erythrophthalmus	1	tr
Ixoreus naevius	1	tr
Scolopacidae	tr	tr
Tetraonidae	tr	1
Unidentified bird	tr	tr
Total	7	1
SALMONID	2	1
VEGETATION	3	tr
EMPTY	17	—

[a] Includes *Microtus oregoni*, *Clethrionomys* sp.
[b] Includes *Sorex vagrans*, *S. trowbridgii*.
[c] tr = items occurring ≤ 0.5%.

overall age differences in food habits, the relative weight of squirrel remains in 76 kitten stomachs averaged 11.4 ± 30.9 g compared to 3.9 ± 17.6 g in 139 adults ($p<0.05$).

In western Washington, birds occurred more often ($p<0.07$) in 67 adult (6%) and kitten females (10%) than 72 adult males (0%), and 9% of the 57 yearling males had eaten birds compared to 2% of the 41 yearling females.

There was a slight difference in the eastern Washington population among the 49 kittens, 17 yearlings, and 48 adults when the relative weights of all prey remains were examined simultaneously ($p<0.09$). Analyses of individual prey items showed that adults averaged 17.7 ± 37.8 g of deer compared to 9.0 ± 19.2 g in kitten ($p<0.05$) and 6.8 ± 24.4 g in yearling ($p<0.10$) stomachs. Also, kittens had consumed an average of 19.3 ± 38.7 g of mice compared to 1.9 ± 8.1 g for yearlings ($p<0.09$). Sixty-five female bobcats had consumed an average of 15.0 ± 33.0 g of red squirrels compared to 8.6 ± 27.9 g for males (n + 49) ($p<0.05$) in the only sex-related dietary difference in the eastern Washington population.

Ten percent of the bobcat kittens in eastern Washington had eaten mammals compared to 24% of the yearlings and 19% of the adults ($p<0.09$). Squirrels occurred in 20% of the female stomachs and 10% of the males ($p<0.10$). Deer remains were found in 16% of the 31 adult and 20% of the 10 yearling females compared to 8% of the 24 kitten females; 24% of the 17 adult males had eaten deer, but none of the 25 kitten or 7 yearling males had ($p<0.10$).

TABLE 2. Stomach contents of 123 eastern Washington bobcats collected from 1976 through 1980.

	Percent occurrence	Relative weight (%)
MAMMALS		
Lagomorphs[a]	20	32
Tamiasciurus hudsonicus	15	14
Odcoilcus sp.	11	21
Microtus sp.[b]	11	6
Peromyscus maniculatus	6	1
Neotoma cinerea	2	2
Glaucomys sabrinus	2	2
Eutamias sp.	2	tr[c]
Erethrizon dorsatum	2	1
Ondatra zibethica	2	3
Marmota sp.	2	1
Citellus sp.	1	1
Castor canadensis	1	2
Sciurus griseus	1	1
Perognathus parvus	1	tr
Unidentified mammal	3	tr
Total	80	85
BIRDS		
Tetraonidae	5	9
Fringillidae	1	tr
Spinus pinus	1	tr
Agelaius phoeniceus	1	tr
Anas platyrhynchos	1	1
Domestic chicken	1	4
Unidentified bird	5	1
Total	15	15
VEGETATION	5	tr
EMPTY	26	—

[a]Includes *Sylvilagus nuttallii, Lepus townsendii, L. californicus.*
[b]Includes *Microtus pennsylvanicus, M. montanus, M. longicaudus.*
[c]tr = items occurring ≤ 0.5%.

DISCUSSION

Mountain beavers were the most important bobcat prey in western Washington. Schwartz and Mitchell (1945) found mountain beavers in only 1.3% of 6 bobcat stomachs and 99 feces examined from northwestern Washington. Nussbaum and Maser (1975) reported mountain beavers in 1.6% and 5.3% of bobcat feces (n=34, 143) from two ranges in western Oregon. Although comparative mountain beaver densities were not indicated in Schwartz and Mitchell's study, the increased use by bobcats in Washington may be a function of mountain beaver availability. Logging and burning in western Washington have increased the proportion of forests in early successional stages (Franklin and Dyrness 1973), providing better habitat for mountain beavers. Mountain beaver densities may have increased with this habitat change and provided a more abundant food resource for bobcats than in previous years.

Evidence of bobcats killing deer has been well documented (Young 1958, Marston 1942, Erickson 1955, McCord 1974). Equal occurrences of deer in the stomachs of all bobcat age classes in western Washington suggests carrion utilization. The greater occurrence of deer in adult diets in eastern Washington indicates either greater carrion use or a higher incidence of predation by more capable hunters.

The higher proportion of empty stomachs and smaller average stomach content weights

for eastern Washington bobcats compared to western Washington specimens may indicate a lower prey base available to eastern Washington bobcats. There was no kitten survival to the winter population on one study area in southeastern Washington, and one radio-instrumented female died overwinter from possible starvation (Knick 1980). In addition, two yearlings collected in eastern Washington were found dead, apparently starved.

Greater use of squirrels by females compared to males in both populations may be the result of females selecting smaller prey than relatively larger males. Fritts and Sealander (1978) showed a greater use of smaller prey items by female bobcats in Arkansas. In contrast, there were no sex-related differences in bobcat diets in eastern Oregon (Toweill 1983). Differential prey exploitation would reduce competition between sexes on shared home ranges (Vaughan 1972).

The greater use of squirrels by kittens compared to adults in western Washington, and mice by kittens compared to yearlings in eastern Washington, suggests that the smaller prey items could be more easily captured by younger animals that had not fully developed hunting skills. Use of mice by kittens, while greater, was not significantly different than by adults in eastern Washington.

The differences in diet between kittens and adults in eastern Washington indicates that young were hunting independently of their mother in this population during this period (Oct.–May). In contrast to our eastern Washington findings, Fritts and Sealander (1978) observed no differences between diets of kittens and adults from stomach samples taken during a period of kitten dependency (Aug.–Nov.)

TABLE 3. Average weight of bobcat stomach contents by age and sex categories.

	Western Washington		Eastern Washington	
	Average weight	N	Average weight	N
Females	175.6 ± 185.9[a]	111	151.5 ± 185.1	49
Males	263.2 ± 284.8	140	190.1 ± 211.3	34
Adults	252.5 ± 266.4	111	209.9 ± 224.6	31
Yearlings	225.3 ± 293.1	82	135.5 ± 185.5	13
Kittens	169.7 ± 169.5	58	144.1 ± 176.5	39
Total	224.5 ± 223.5	251	167.3 ± 171.5	83

[a] $\bar{X}$ ± SD

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